REMARKS

Reexamination and reconsideration of the rejections are hereby requested.

Claims 1-27 are pending in this application. Claims 1 and 17 are independent claims. As set forth in claim 1, the invention is a high compression ratio, homogeneous charge compression ignition/spark ignition dual mode engine. A first mode employs homogenous charge compression ignition at low- and mid-load levels and a second mode employs spark ignition at high-load levels. The second mode includes the addition of hydrogen or a hydrogen/carbon monoxide mixture in the engine. As discussed in the specification of the present patent application, when high compression ratios are used there can be a severe knock problem in the spark ignition operating mode. Thus, in this second, spark ignition mode the hydrogen or hydrogen/carbon monoxide is added to enhance knock resistance. The benefits of a high compression ratio can be gained in the low-load regime using homogenous charge compression ignition and in the high-load regime using spark ignition with hydrogen addition. Claim 1 explicitly recites that the hydrogen or hydrogen/carbon monoxide mixture is added in the second, spark ignition mode.

Independent claim 17 is directed to a high compression ratio, homogenous charge compression ignition engine operating on a high cetane fuel along with the addition of hydrogen or a hydrogen/carbon monoxide mixture at low-to-mid-load levels.

Claims 1-10, 12-24, 26, and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over zur Loye et al., U. S. Patent No. 6,684,849 in view of Cueman, U. S. Patent No. 6,866,016. Dependent claims 11 and 25 stand rejected under 35 U. S.C. 103(a) as being unpatentable over zur Loye et al., in view of Daniel et al., U. S. Published Application 2003/0047147.

The zur Loye reference is directed to a multiple operating mode engine that can involve two different fuels. In one relevant embodiment, zur Loye teaches a transition from a

homogenous charge compression ignition ("HCCI") mode to a spark ignition mode. Zur Loye teaches that in the HCCI mode one can use a second fuel such a natural gas or propane in addition to a first or primary fuel such as diesel fuel, kerosene or gasoline. Importantly, the zur Loye spark ignition mode utilizes only a single fuel. The Examiner's attention is directed to zur Loye beginning at column 5, line 65. Zur Loye states "The control system may also cause the fuel delivery system to deliver an early pilot quantity of the first fuel prior to a start of combustion of a pre-mixed charge of the second fuel and air in the combustion chamber when in the pre-mixed charge compression ignition mode."

There is no teaching whatsoever in zur Loye to use a second fuel in the spark ignition mode. The Examiner has combined the teachings of zur Loye with those Cueman. Cueman is directed to an HCCI engine in which a pilot fuel that may be hydrogen is injected to initiate combustion of a diesel fuel. Cueman's engine is a single mode engine and the addition of the pilot fuel comes during the HCCI operation. Thus, zur Loye and Cueman both teach introduction of a second fuel only during operation in the HCCI mode. The combined teachings of zur Loye and Cueman therefore do not suggest the addition of hydrogen or a hydrogen/carbon monoxide during a spark ignition mode.

To summarize this argument, claim 1 in the present application recites a dual mode engine having a first mode employing HCCI on a single fuel and a second mode employing spark ignition with the addition of hydrogen or a hydrogen/carbon monoxide mixture. By contrast, the combined teachings of zur Loye and Cueman are the opposite of the claimed invention. That is, zur Loye and Cueman teach the addition of a second fuel that may be hydrogen in the HCCI mode rather than in the spark ignition mode as explicitly set out in claim 1. Thus, the combined teachings of zur Loye and Cueman teach away from claim 1's

requirement of adding hydrogen or a hydrogen/carbon monoxide mixture during the spark ignition mode. Reconsideration of the rejection of independent claim 1 is requested.

Independent claim 17 is directed to a high compression ratio, homogenous charge compression ignition engine operating on a high cetane fuel along with the addition of hydrogen or a hydrogen/carbon monoxide at low-to-mid-load levels. This claim has also been rejected as unpatentable over zur Loye in view Cueman. While Cueman teaches the introduction of hydrogen as a pilot fuel to ignite a main fuel such as diesel fuel, there is no teaching that that introduction is at low-to-mid-load levels. Cueman is silent as to when the hydrogen should be introduced. Furthermore, Cueman teaches the introduction of hydrogen to help ignite a hard-to-ignite fuel such as diesel fuel. In contrast, the present specification at page 7, beginning at line 12 teaches that hydrogen addition makes compression ignition more difficult so that one can use a cetane diesel fuel with HCCI-like combustion. Thus, a cetane fuel can be used at low-to-mid level loads which would otherwise have required a low cetane fuel.

Claims 11 and 25 stand rejected under 35 U. S. C. 103(a) as being unpatentable over zur Loye et al. in view of Daniel. Although Daniel discloses a plasmatron reformer, dependent claims 11 and 25 ultimately depend from independent claims 1 and 17 respectively and are therefore allowable as depending from allowable claims as discussed above.

For the foregoing reasons, it is submitted that the pending claims are in condition for allowance and early favorable action is requested.

Respectfully submitted,

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